METHOD AND APPARATUS FOR CONTROLLING AT LEAST ONE SET-TOP BOX

Technical field

This invention relates to controlling set-top boxes in a television-related environment.

Background Art

Originally, televisions possessed a simple user interface containing a channel selector, volume control and little else. Since the advent of video tape technology, these controls have been extended far beyond this.

A standard approach to controlling what are now known as set-top boxes is the use of hand held remote control devices using Infra-Red (IR) signals to communicate with set-top boxes and recently with additional devices, often found in home entertainment centers. There have been set-top control units also controlling other devices with this IR blasting technology which are not hand held. To date, these IR blasters have been driven by an embedded microprocessor using an embedded non-volatile memory chip to store the control tables specifying the IR signaling required for communication with various devices. Such devices are now pervasive throughout the consumer electronics of many continents.

However, such devices have some limitations that often cause significant frustration. Non-volatile memory chips used in such IR controllers offer limited amounts of memory, usually no more than one megabit. Such small memories are limited in terms of holding the rapidly growing database of distinctive device protocols in use by the various consumer devices. It is a common problem that a device operating in the correct frequency range cannot generate the necessary

signaling to adequately communicate with a newly purchased device such as a set-top box component in a home entertainment center.

Another problem often encountered, even when a device may be able to add the control information to communicate with a new device, is that there is no readily supported mechanism by which that information can be programmed into the non-volatile memory chip.

Another problem encountered is the inability of contemporary IR controllers to select channels located on both A and B switch settings of a set-top box. Worse yet, existing IR controllers are further unable to select channels on these two setting as well as support the C band setting used in some satellite television services.

Another problem encountered in contemporary IR controllers is that different set-top boxes require essentially syntactic presentation controls. These set-top boxes have different responses to signals, often requiring specific minimum delays between digits or symbols being IR blasted to them. Another similar problem comes in the use of enter or cancel keys to delimit ending an IR blasting sequence. Another similar problem is establishing how many digits are expected to define a channel. In each of these problems, variations among different set-top boxes lead to a lack of uniformity challenging the patience of consumers, because today, there is no solution to any of these problems.

To summarize, what is needed includes IR blasting controls not limited to a small non-volatile memory capacity for holding signaling details for various units controlled by IR blasting. What is further needed includes a mechanism or method for rapidly updating an existing IR blaster control unit to incorporate signaling details for new devices. What is also further needed is a flexible ability to support channel selection on A/B switch and A/B/C switch controlled set-top box systems. What is further needed is a method of solving essentially syntactic presentation control problems.

Disclosure of the invention

Various embodiments solve all of these problems.

Certain embodiments include a method and apparatus for providing control of a set-top box through IR blasting control by a system containing at least one computer: the system is coupled to a mass storage system. These embodiments include providing an IR control database residing on the mass storage system where the IR control database contains at least one IR control entry, providing an IR control packet where the IR control packet is generated from a first IR control entry of the IR control database, and providing control to the set-top box by serial transmission of the IR control packet.

These embodiments are advantageous in providing an IR control database residing on the mass storage system. Such solutions remove any memory constraints on the size of the IR control database, thus solving the memory constraint problem of the prior art.

Certain further embodiments additionally include the following: Providing an IR control database residing on the mass storage system, where the IR control database contains at least one IR control entry; providing reception of an IR control entry to create a received IR control entry; and providing insertion of the received IR control entry to create the first IR control entry of the IR control database.

Such embodiments are advantageous in supporting the reception of updates and additions to the IR control database remotely. By way of example, such embodiments facilitate IR blasting control code signaling protocol upgrades as new equipment is integrated into a home entertainment system

Certain further embodiments additionally include the following: Providing a raw IR control library residing on the mass storage system, where the raw IR control

library contains a first raw IR control entry; providing library parsing of the first raw IR control entry of the raw IR control library to create a processed first IR control entry; and providing communication of the processed first IR control entry to create the first IR control entry of the IR control database.

Such embodiments advantageously support a raw IR control library to be acquired, shared and updated with other manufacturers.

Certain other further embodiments additionally include the following: Providing a prototype IR control database residing on the mass storage system, where the prototype IR control database contains a first prototype IR control entry; providing a control code search accessing the prototype IR control database to select a first prototype IR control entry; and generating from the first IR control entry the first raw IR control entry of the raw IR control library.

Such embodiments are advantageous in providing a systematic interface between a prototype laboratory and the raw IR data library. Such an interface permits automated updating of the raw IR data library, which in turn supports automated updating of the IR control database through the library parsing mechanism.

Certain other further embodiments additionally include the following: Providing a corrections-additions database residing on the mass storage system, where the corrections-additions database contains a first correction data entry; and providing the library parsing of the first correction data entry and of the first raw IR control entry to create the processed first IR control entry.

Such embodiments advantageously support corrections and additions to the control code tables which may be the result of continued testing beyond a prototype initial coding situation.

Certain other further embodiments additionally include the following: The processed first IR control entry includes a first processed IR control entry syntax specification; and the first IR control entry of the IR control database includes a first IR control syntax specification. Such embodiments advantageously support including essentially syntactic presentation controls into an IR control entry.

Certain further embodiments comprise a first IR control syntax specification which is included in the first IR control entry of the IR control database, including a number of digits in a channel specification. Such embodiments advantageously support specification of the number of digits in a channel specification.

Certain other further embodiments comprise a first IR control syntax specification entry which is included in the first IR control entry of the IR control database, including a delimiter specification ending an IR blast. Such embodiments advantageously support delimiter specifications ending an IR blast.

Certain other further embodiments include the first IR control syntax specification entry which is included in the first IR control entry of the IR control databas, including a delay specification between digits of an IR blast. Such embodiments advantageously support specifying delays between digits of an IR blast.

Certain other further embodiments include the first IR control syntax specification entry included in the first IR control entry of the IR control database including a prefix specification. Such embodiments advantageously support specifying prefix symbols in an IR blast.

Certain further embodiments comprise a prefix specification which is included in the first IR control syntax specification entry which is, in turn, included in the first IR control entry of the IR control database and which comprises an A/B switch prefix selection. Such embodiments advantageously support channel selection of both A channels and B channels.

Certain other further embodiments comprise a prefix specification which is included in the first IR control syntax specification entry which is, in turn, included in the first IR control entry of the IR control database and which comprises an A/B/C switch prefix selection. Such embodiments advantageously support additional channel selection of C channels.

Certain other further embodiments additionally comprise a system containing one computer. Such embodiments advantageously include the ability to develop prototyping IR blasting codes in an environment containing the standard (lower cost) consumer version to insure compatibility.

Certain other further embodiments additionally comprise a system containing a first computer and a second computer. The mass storage system comprises a first mass storage system coupled to the first computer and a second mass storage system coupled to the second computer. The IR control database comprises a first instance of the IR control database residing on the first mass storage system coupled to the first computer. The raw IR control library resides on the second mass storage system containing the first raw IR control entry. The system provides reception of the IR control entry to create a received first IR control entry using a method which includes providing reception of the IR control entry to create the received first IR control entry at the first computer.

Such embodiments advantageously support distribution of library parsed data entries from a raw IR control library which resides on the second mass storage system coupled to the second computer to IR control database instances which resides on the first mass storage system coupled to the first computer. Note that in certain embodiments, the second computer is a server or distributor for IR control blasting code updates to numerous first computers in various consumers' set-top box control units.

Certain other further embodiments additionally include the system further containing a server computer system which provides reception of the IR control

entry to create a received first IR control entry and that includes providing reception of the IR control entry to create a received first IR control entry by the server computer system.

Communication of the processed first IR control entry by the second computer to create the first IR control entry of the IR control database includes the following. Providing communication of the processed first IR control entry by the second computer to create the first IR control entry by the server computer system; and providing communication of the processed first IR control entry by the server computer system to create the first IR control entry of the first instance of the IR control database by the first computer.

Such embodiments advantageously provide a partitioning of the second computer and second mass storage system holding the raw IR control library from a server computer actually distributing IR control code updates to at least one first computer.

Brief Description of the Drawings

Figure **1** depicts a system controlling a set-top box in accordance with certain embodiments;

Figure **2** depicts a system block diagram in accordance with certain embodiments;

Figure **3** depicts data flow regarding IR control of external set-top boxes in accordance with certain embodiments;

Figure **4** depicts a refinement of Figure **1** regarding IR control of external set-top boxes in accordance with certain embodiments;

Figure **5** depicts a system controlling a set-top box using a prototype test unit in accordance with certain embodiments;

Figure **6** depicts a network with server system **104**, a prototype set-top control system **102** and multiple set-top control systems **100-1** to **100-4**; and

Figure **7** depicts a hand held remote control unit **120** in accordance with certain embodiments.

Detailed Description of the Invention

Figure **1** depicts a system **100** including set-top control unit **110** controlling an external set-top box **200** in accordance with certain embodiments.

Certain embodiments are implemented as an advanced set-top unit **110** packaged in a shipping container with cables, accessories, and a remote control **120**. Certain further embodiments provide control of cable and satellite set-top boxes **200** by IR control **114**. Certain embodiments support some satellite boxes **200** by serial control **114**. In certain embodiments, remote control unit **120** may be a TiVo Remote Control Unit, manufactured by or for TiVo, Inc. of San Jose, California.

The television source **202** can be from one of four sources: 1) a roof-top antenna or rabbit ears receiving terrestrial analog broadcast, 2) a buried coaxial cable delivering analog and digital cable signals, 3) a satellite antenna receiver digital satellite broadcast, and 4) a roof-top antenna receiving terrestrial digital broadcast.

If the signal source **202** is from a roof-top or rabbit ear antenna, the user connects the cable from the antenna directly to the RF input on the Set-top control unit. The internal tuner in the Set-top control unit set-top box is used to select which program to view or record. The viewer selects which channel to tune to by using the remote control unit **120**. After the selection is made, the Set-top control unit tunes its internal tuner to receive the channel selected.

If the signal source **202** is from a buried cable from a cable provider, the user can choose to 1) connect the cable to a analog set-top box, 2) connect the cable to a digital set-top box, or 3) connect the cable directly to the Set-top control unit. Note that in certain embodiments, the cable may be fiber optic. In certain other embodiments, the cable may be coaxial cable.

If the signal source **202** is from cable and the user has an analog cable set-top box, the cable is connected to the cable set-top box. Note that in certain embodiments, the cable may be fiber optic. In certain other embodiments, the cable may be coaxial cable. The cable set-top box contains an internal tuner that will be tuned to the channel the viewer wishes to view or record. The cable set-top box **200** is then connected **118** to the Set-top control unit **110** in one of two ways. 1) The channel selected is modulated onto either channel 3 or 4 and output on a RF connector. The RF connector is connected **118** to the RF input connector on the Set-top control unit **110** And the internal tuner **640** (see Figure **2**) in the Set-top control unit **110** is tuned to channel 3 or 4 to receive the channel. 2) The channel selected is output on either a composite or s-video connectors. These connectors are connected **118** to composite or s-video inputs on the Set-top control unit **110**. If available, the preferred connection **118** is using s-video; if s-video is not provided then the preferred connection **118** is composite in certain embodiments. Both s-video and composite provide higher quality connections **118** than RF in certain embodiments.

The viewer selects which channel to tune to by using the Remote Control Unit **120**. After the selection is made, the set-top control unit **110** transmits an IR signal **114** to the Cable set-top box **200** and the Cable set-top box **200** tunes its internal tuner to the channel. The channel is passed to the set-top control unit **110** by either the RF, composite, or s-video outputs. The set-top control unit **110** must be configured to receive the channel from its RF, composite, or s-video inputs. If the RF input is selected, the Set-top control unit **110** must also tune its

internal tuner **640** (see Figure **2**) to either channel 3 or 4, depending upon which channel the cable box **200** is configured to receive the signal.

If the signal source **202** is from cable and the user has a digital cable set-top box **200**, the cable **118** is connected to the digital cable set-top box **200**. Note that in certain embodiments, the cable may be fiber optic. In certain other embodiments, the cable may be coaxial cable. The digital cable set-top box **200** contains an internal tuner that will be tuned to the channel the viewer wishes to view or record. The cable set-top box **200** connects **118** to the set-top control unit **110** in one of two ways. 1) The selected channel is modulated on either channel 3 or 4 and output on a RF connector. The RF connector is connected to the RF input connector on the Set-top control unit **110**. And the internal tuner in the Set-top control unit **110** is tuned to channel 3 or 4 to receive the channel. 2) The channel selected is output on either a composite or s-video connectors. These connectors are connected to composite or s-video inputs on the Set-top control unit **110**. Using the s-video connectors in certain embodiments provides the highest quality connection.

The viewer selects which channel to tune to by using the TiVo Remote Control Unit **120**. After the selection is made, the Set-top control unit **110** transmits **114** an IR signal to the digital cable set-top box **200** and the digital cable set-top box **200** tunes its internal tuner to the channel. The channel is passed **118** to the TiVo set-top unit **110** by either the RF, composite, or s-video outputs. The TiVo set-top unit **110** must be configured to receive **118** the channel from its RF, composite, or s-video inputs. If the RF input is selected, the Set-top control unit **110** must also tune its internal tuner **640** (see Figure **2**) to either channel 3 or 4, depending on which channel the digital cable box **200** is configured to receive the signal.

If the signal source **202** is from a satellite antenna, the satellite receiver digital set-top box **200** is connected **118** to the Set-top control unit **110** in an identical fashion as described above for a digital cable set-top box **200**. As many satellite

receivers also require a cable or terrestrial broadcast antenna to receive local channels, the preferred connection for a satellite receiver is using the s-video connectors in certain embodiments for the highest quality connection. Such connection also leaves the RF input connection on the Set-top control unit **110** free to attach cable or roof-top antenna to receive local channels.

Some digital satellite receivers support serial data ports. If so, rather than use IR to control the satellite receiver set-top box **200**, the serial output port **508** (see Figure **2**) on the Set-top control unit **110** can be connected **114** to the serial data port on the satellite receiver.

If the signal source **202** is from a digital terrestrial antenna and the digital terrestrial set-top box **200** provides an option to output standard NTSC compatible video on either RF, composite, or s-video outputs. Then one of these outputs can be connected **118** to the corresponding input on the Set-top control unit **110**. The digital terrestrial set-top box **200** is connected **118** to the Set-top control unit **110** in an identical fashion as described above for a digital cable set-top box **200**. The connection **118** using s-video provides the highest quality connection in certain embodiments.

Certain embodiments provide server based services through modem access **116**. Certain further embodiments provide server based services that include TiVo™ Services through modem access **116**.

Certain further embodiments support at least some of the following features: Records television programming in digital form on at least one internal hard disk drive. Certain further embodiments support 14 hours of recorded programming and certain other further embodiments support 30 hours of programming. Certain embodiments support digital recording of audio-video content including random access to titled programming. Certain further embodiments support digitally accurate fast forward, rewind, slow motion, frame forward, frame back and high-quality freeze frame. Certain embodiments provide a 30 minute buffer of live

programming being viewed enabling view to pause, rewind and fast forward live TV.

Certain embodiments provide instant replay of live or recorded sporting events and educational programs. Certain embodiments provide a bookmarking feature to record to save the rest of a current program being watch to view later. Certain embodiments provide programmable scheduling by time and channel, just like a VCR. Certain embodiments allow viewers to save recorded programs to their VCRs. Certain embodiments provide selectable recording quality.

Certain embodiments provide a RF input **644** with tuner **640**, which is compatible with cable and terrestrial broadcast TV (see Figure **2**). Certain embodiments provide selectable RF input on channel 3, RF input on channel 4, composite or S-Video input support for analog cable, digital cable, or satellite set-top boxes.

In certain embodiments, a set-top control unit **110** electronics are housed in a metal enclosure approximately 17 inch wide, 13 inches deep and 4 inches high. The receiver supports one disk drive, providing up to 14 hours of program storage. In certain other embodiments, a 30 hour model of Set-top control unit **110** is identical to the 14 hour model except it supports two disk drives, providing up to 30 hours of program storage.

Television **130** is fed **132** from set-top control unit **110** in certain embodiments. In certain further embodiments, connection **132** feeds signals from a composite video output **550** (see Figure **2**) of set-top control unit **110**. In certain other further embodiments, connection **132** feeds signals from an S-video output **548** (see Figure **2**) of set-top control unit **110**.

In certain embodiments, remote control unit **120** provides a wireless **122** control television **130**.

Figure **2** depicts a system block diagram set-top control unit **110** in accordance with certain embodiments.

In certain embodiments, the electronics of set-top control unit **110** consists of a main System Board **400**, an IR Controller Board (IR Ctrl) **620**, a mass storage system **600**, a Fan, and a Power Supply. Set-top control unit **110** supports one left-right stereo pair audio input **532-534**, one composite video input **522**, one S-Video input **524**, one RF input **644** and one RF output **642** modulated onto either channel 3 or 4.

Mass storage system **600** may include one or two IDE Disk Drives in certain embodiments. Set-top control unit **110** mass storage system **600** supports 1 or 2 IDE disk drives providing storage for up to 30 hours of programming.

The set-top control unit **110** provides at least one left-right stereo pair audio outputs **544-546**, at least one composite video output **550**, at least one S-Video output **548**, at least one serial input/output **508**, at least one IR blaster output **622**, and at least one modem input/output **510** which may be connected **116** to an associated phone line in certain embodiments. In certain further embodiments, a 33.3Kbit modem is used.

The electronics within the area denoted by **400** is located on the System Board. The IR Controller Board (IR Ctrl) **620** is manufactured as part of the System Board, detached during assembly, and electrically connected with a ribbon cable. This allows the IR Controller board **620** to be physically attached to the front panel of the enclosure. The disk drive(s) in mass storage system **600** are connected by a ribbon cable **564** to the System Board **400**. The Fan is connected to the System Board **400** with a cable **562**. The Power Supply is connected to the System Board **400** and mass storage system **600** with power cables.

The system board **400** can be generally divided into 1) subsystems that convert analog video and audio from analog to digital data, 2) subsystems that process

digital audio and video data, and 3) subsystems that convert digital data back to analog.

The Tuner subsystem **640** and video and audio input subsystem **620** accept as input standard analog video and audio signals from set-top boxes, roof-top antennas, or rabbit ear antennas. The video and audio input subsystem **620** converts these signals into digital media streams.

The digital media streams **536** and **502** are processed and stored in the mass storage system **600** by Media Switch **560** and Processor Subsystems **500**. Media streams **542** selected by the user to view are retrieved **564** from the mass storage system **600** by the Media Switch **560** and Processor Subsystem **500**. Retrieved media stream **542** is converted from digital to analog by the Video and Audio Output Subsystem **540**. Media Switch **560** and Processor Subsystem **500** also perform miscellaneous house keeping functions such as temperature monitoring and fan control **562**. The Security Microprocessor **580** performs system identification and authentication for security purposes.

The System Board partitions into CPU, Input, and Output Subsystems. Each subsystem will be discussed in more detail below.

The Processor subsystem **500** includes the following in certain embodiments. The CPU is an IBM Power PC. The boot ROM is a 1 mega-bit Flash. The main memory is 4 meg x 32-bit, implemented using two 4096kx16-bit EDO RAMs. The IBM serial port is multiplexed to interface to the IR Controller Board and the Security Microprocessor. A second serial UART implements the external serial port that controls DSS Receivers. The modem is implemented with a Rockwell chipset and has an attached 1 mega-bit Flash that contains its microcode. The Media Switch ASIC controls multimedia streams to and from the disk drive. It also implements a number of system functions including the IDE disk drive controller, fan control and i2C bus control. The CPU Subsystem has a battery backed-up real-time clock and a temperature sensor interfaced to the i2C bus.

The i2C bus is also used to control **502** Video and Audio Input system **620** and to control **506** Video and Audio Output Subsystem **540**.

The Video and Audio Input Subsystem **620** inputs video and audio from I/O connectors, converts it from analog to digital and encodes it using MPEG2 compression. Channel selection is performed with a tuner **640** when the RF input is selected. The video and audio are converted from analog to digital and then passed to a compression engine. In certain embodiments, only one video/audio source can be selected at a time to be processed by the compression engine.

The video compression is performed with an MPEG encoder chip set in certain embodiments. In certain embodiments, an MPEG encoder chip set coupled with RAM memories performs video compression. In certain further embodiments, the MPEG encoder chip set is composed of exactly one integrated circuit. A Sony MPEG2 encoder chip performs video compression in certain further embodiments. A DSP is used in certain embodiments to perform audio compression. In certain further embodiments, a DSP from Analog Devices is used to perform audio compression.

The Video and Audio Output Subsystem **540** decompresses video and audio cached on mass storage system **600**, converts it back into analog signals, and drives the output connectors. Certain embodiments of set-top control unit **110** support at least one stereo pair of audio output, at least one composite video outputs, at least one S-Video output and at least one RF output modulated onto either channels 3 or 4. Certain further embodiments of set-top control unit **110** support at least two stereo pair of audio output and at least two composite video outputs.

The compressed video/audio stream **542** is transferred to an MPEG2 decoder chip set for decoding in certain embodiments. In certain further embodiments the MPEG decoder chip set is coupled to RAM memory. The compressed

video/audio stream **542** is transferred to an IBM MPEG2 decoder chip with coupled RAM memory for decoding in certain further embodiments.

The uncompressed digital video, output by the MPEG decoder chip set, is sent to a video encoder to convert the video back into analog form before driving the video output connectors in certain embodiments. In certain further embodiments, a Phillips video encoder chip performs the conversion. Audio is mixed with user interface sound effects before driving the audio output connectors in certain embodiments. Audio is converted from digital into analog and then mixed with user interface sound effects before driving the audio output connectors in certain further embodiments.

The IR Controller Board **620** contains an IR Microcontroller, an IR Photo receiver module, and LED's indicators. IR controller board **620** is connected **514** to the System Board with a ribbon cable that connects the IR Microcontroller to the Power PC using the Power PC's serial port in certain embodiments.

Set-top control unit **110** mass storage system **600** supports two disk drive bays in certain embodiments. The 14 hour Set-top control unit **110** has one 3-1/2 inch IDE disk drives in its mass storage system **600**, supporting up to 14 hours of programming. The 30 hour Set-top control unit **110** has one or two 3-1/2 inch IDE disk drives in its mass storage system **600**, supporting up to 30 hours of programming. The power for the disk drives is connected directly from the power supply. The IDE interfaces of the drives are connected **564** to the System board with a flat ribbon cable.

Note that in certain embodiments, IR control codes are stored in an IR control code database **1100** (see Figure **3**) residing on mass storage system **600**.

Figure **3** depicts data flow regarding IR control of external set-top boxes in accordance with certain embodiments.

In certain embodiments, IR control database **1100** resides on the mass storage system **600** and contains at least one IR control entry. A first IR control entry is accessed **1102** to IR control generator **1110**. IR control generator **1110** processes the IR control entry and sends **1112-1122** it to be prepared **1130** for presentation **1132** to a serial device **1140**. Serial device **1140** serially transmits this presented information as control signals to an external set-top box.

In certain further embodiments, timing generation **1120** is performed before **1122** it is prepared **1130** for presentation **1132** to a serial device **1140**. In certain embodiments, preparation **1130** includes processing similar to the "C" programming language function "sprintf". In certain further embodiments, preparation **1130** includes multiplexing serial streams to be sent to serial device **1140**. In certain further embodiments, preparation **1130** includes queuing various multiplexed serial streams to be sent to serial device **1140**.

In certain embodiments, the serial device **1140** includes at least one IR controller. In certain further embodiments, the serial device **1140** further includes a second serial device physical transport layer, which may include either wireline or wireless transport mechanisms.

In certain embodiments, raw IR control library **1180** resides on the mass storage system **600** and contains at least one raw IR control entry. A first raw IR control entry is accessed **1182** by a library parsing operation **1190** to create a processed first IR control entry. The processed first IR control entry is communicated **1192** and received **1192** to create a received first IR control entry. The received first IR control entry is inserted into IR control database **1100** as an IR control entry of the IR control database **1100**.

In certain further embodiments, first raw IR control entry is accessed **1182** by a library parsing operation **1190** to create a processed first IR control entry syntactic specification. The processed first IR control entry syntactic specification

is communicated **1192** and received **1192** to create a received first IR control entry.

Syntactic specifications provide for the specification of many crucial forms of communication information in an IR control entry. This includes but is not limited to specification of how many digits are in a channel. This also includes but is not limited to specifying whether an enter or cancel key is used at the end of IR blasting sequence to delimit channels. This also includes but is not limited to specifying delays between transmission of digits or symbols. This also includes but is not limited to specifying prefix keys. Prefix keys are not digits, which may used to delimit switch settings in certain embodiments. Many set-top boxes have an A/B switch, often with channels on both A and B switch settings. Some set-top boxes supporting satellite reception further have a C-band switch setting. This also includes but is not limited to specifying postfix keys. Postfix keys are not digits which alter the interpretation of the preceding IR blasting sequence.

Note that a syntactic specification may be the entire IR control entry, or a part of the entry.

This also includes but is not limited to syntactic specifying IR control entries further referencing other syntactic specifying IR control entries. This supports development of complex blasting codes to perform essentially macro operations.

In certain further embodiments, the first raw IR control entry is accessed **1184** by raw data IR generator **1200** to create a raw IR control packet, which processes the raw IR control packet and sends **1202-1122** it to be prepared **1130** for presentation **1132** to a serial device **1140**. Serial device **1140** serially transmits this presented information as control signals to an external set-top box.

In certain further embodiments, timing generation **1120** is performed before **1122** it is prepared **1130** for presentation **1132** to a serial device **1140**. In certain embodiments, preparation **1130** includes processing similar to the "C"

programming language function "sprintf". In certain further embodiments, preparation **1130** includes multiplexing serial streams to be sent to serial device **1140**. In certain further embodiments, preparation **1130** includes queuing various multiplexed serial streams to be sent to serial device **1140**.

In certain embodiments, a prototype IR control database **1150** resides on mass storage system **600** containing at least one prototype IR control entry. A control code search **1160** accessing **1152** a first prototype IR control entry creates a first raw IR control entry for raw IR control library **1180**. In certain further embodiments, the first prototype IR control entry is accessed **1154** by timing interface **1160** to create a first IR control packet, which then follows the same data flow **1122** as has been previously described. Note that in certain further embodiments, the prototype IR control database is compatible with the PRONTO device database, based upon the PRONTO products manufactured by Philips.

Figure **4** depicts a refinement of Figure 1 regarding IR control of external set-top boxes in accordance with certain embodiments. Note that the entire discussion regarding Figure **3** is applicable to this figure and will not be repeated to simplify and focus the discussion on the additional elements of this figure.

In certain embodiments, corrections-additions database **1210** resides on mass storage **600** and may contain a first correction entry. In addition to the first raw IR control entry being accessed **1182** by library parsing operation **1190** to create a processed first IR control entry, there are additional activities in certain further embodiments. A first raw IR control entry is accessed **1182** and a first correction entry is accessed **1212** by a library parsing operation **1190** to create a processed IR control entry. This processed IR control entry may replace the processed first IR control entry which was generated based strictly upon accessing **1182** the raw IR control library **1180**. This processed IR control entry may be in addition to the processed first IR control entry which was generated based strictly upon accessing **1182** the raw IR control library **1180**.

Figure **5** depicts a system controlling a set-top box using a prototype test unit in accordance with certain embodiments.

This figure is a refinement of Figure **1**, and shares all of the discussion of Figure **1**. As such that discussion will not be repeated and the focus herein will be on the interaction of the new element, a prototype test unit **140** which is coupled **142** to an implementation of set-top control unit **110** and further coupled **144** to the IR control unit **120**.

In certain embodiments, a new IR control unit **120** may be encountered which possesses a distinctive control signaling protocol. Prototype test unit **140** receives the IR blasted codes from the remote control unit **120**, which it then formats and enters into the prototype IR control database **1150** (see Figures **3** and **4**). Through a procedure of successive experimental steps, the IR control codes necessary to fully interface with the remote control unit **120** are discerned and entered into the prototype IR control database **1150**. Line **116** may then be used to transmit this updated or new information to other systems including set-top control units **110**, or servers, which in turn may distribute such updated or new information to other systems including set-top control units **110**.

Note that in almost all cases today, new set-top box units are shipped with a hand held remote control unit **120** which is specifically configured to work with the new set-top box unit. A user of a set-top box control unit as depicted in Figure **1** need only ship the hand held IR control unit **120** to a central site containing a system as in this figure. The system as shown in this figure determines the specific IR control signaling needed to interface with the new set-top box. The communication line **116** of the consumer unit of Figure **1** is then utilized to download the newly determined specific IR control signaling necessary to control their new set-top box unit.

Figure **6** depicts a network with server system **104**, a prototype set-top control system **102** and multiple set-top control systems **100-1** to **100-4**.

Continuing the discussion from the previous figure, this figure depicts an embodiment of the invention wherein multiple set-top control systems **100-1** to **100-4** share the advantages of access to prototype set-top control system **102**. In certain embodiments, server system **104** may only act to distribute updates on a data entry by data entry level. In certain further embodiments server system **104** may store the entire IR control database for downloading by any of the **100** systems.

Figure **7** depicts a hand held remote control unit **120** in accordance with certain embodiments.

Note that the remote control **120** specification is detailed in a document entitled "Remote Control Specification SRCU-00001-000 A" which is included as appendix A herein.

Although the invention is preferably described herein with reference to the preferred embodiment, one skilled in the art will readily appreciate that other applications may be substituted for those set forth herein without departing from the spirit and scope of the present invention. Accordingly, the invention should only be limited by the Claims included below.